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Chemicals in waste materials and Life Cycle Assessment

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Introduction

Chemicals are inherent part of materials and products. A variety of chemicals is used in different materials (paper, plastics, textiles, etc.), as well as products made of those materials (toilet paper, drinking bottles, denim trousers, etc.). Once the products become obsolete, their value is being retained in the society through material recycling. Increasing share of waste products is being recycled and there is an outlook for even higher material recycling rates in the future. Once the waste products are recycled, chemicals they contain are also recycled. If the chemicals are not completely removed in a recycling process, this may lead to deterioration of material quality and increasing human exposure to potentially harmful chemicals. Presence of chemicals in recycled materials has not been comprehensively addressed in the life cycle assessment (LCA) methodology.

The objective of this work is to raise awareness of the issue of chemical contamination from material recycling and point out main methodological challenges when performing LCA of waste management technologies and systems.

Discussion

While there is some information concerning the presence of chemicals in materials and articles (e.g., Pivnenko et al., 2017, 2016), the types and amounts of chemicals vary depending on the material, its processing and its applications. This makes control of the chemical composition of recycled materials challenging and could potentially lead to contamination and contaminant accumulation (Pivnenko et al., 2016). When assessing and comparing waste management alternatives, LCA is commonly used. LCA methodology takes into account emissions resulting from a variety of processes in a product's lifespan; however, "emissions" (evaporation, migration, etc.) of chemicals resulting from the use of recycled materials are not taken into account. Introduction of an additional chemical load through recycling may lead to an elevated exposure to a chemical. Such exposure is commonly addressed using Risk Assessment (RA) methodology. RA is not directly compatible with the LCA methodology, i.e., the former identifies whether or not there is a risk of using a specific product, while the latter provides a quantitative result (toxicity score) based on use of characterization factors. When comparing waste management alternatives, using LCA tool only may lead to incomplete assessment. Possible environmental benefits shall be balanced with potential risk of chemical exposure.

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